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(54) Hand drill, especially a hammer drill

(57) A hand drill having a tool holder (13), which possesses a jaw chuck, has a first tool-holding fixture (11) on the outer casing (16) of a driven hollow spindle (15). The end (17) of a hollow spindle (15) facing the tool holder (13) engages in the through-opening (14) and has rotational drivers (36) for the grooved shank (37, Fig. 2) of a tool (43, Fig. 2) which can be inserted into a second tool-holding fixture (12). The tool holder (13) is constructed as an unhardened component which is easy to produce, thereby avoiding hardening deformation and, consequently, substantially improving the concentricity characteristics. A percussive element 20 acts on the tool to impart a hammer action. The tool holder may having an axial locking pin (26, Fig. 6) to limit axial movement of the tool.

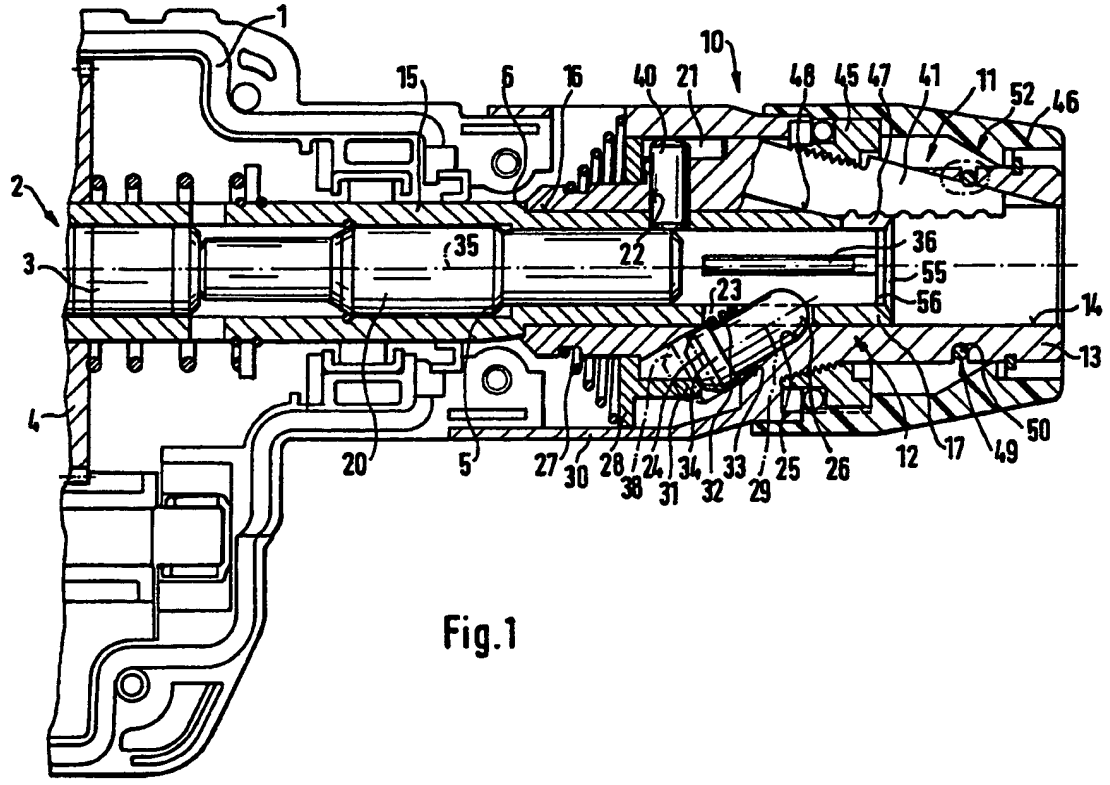

Fig.1

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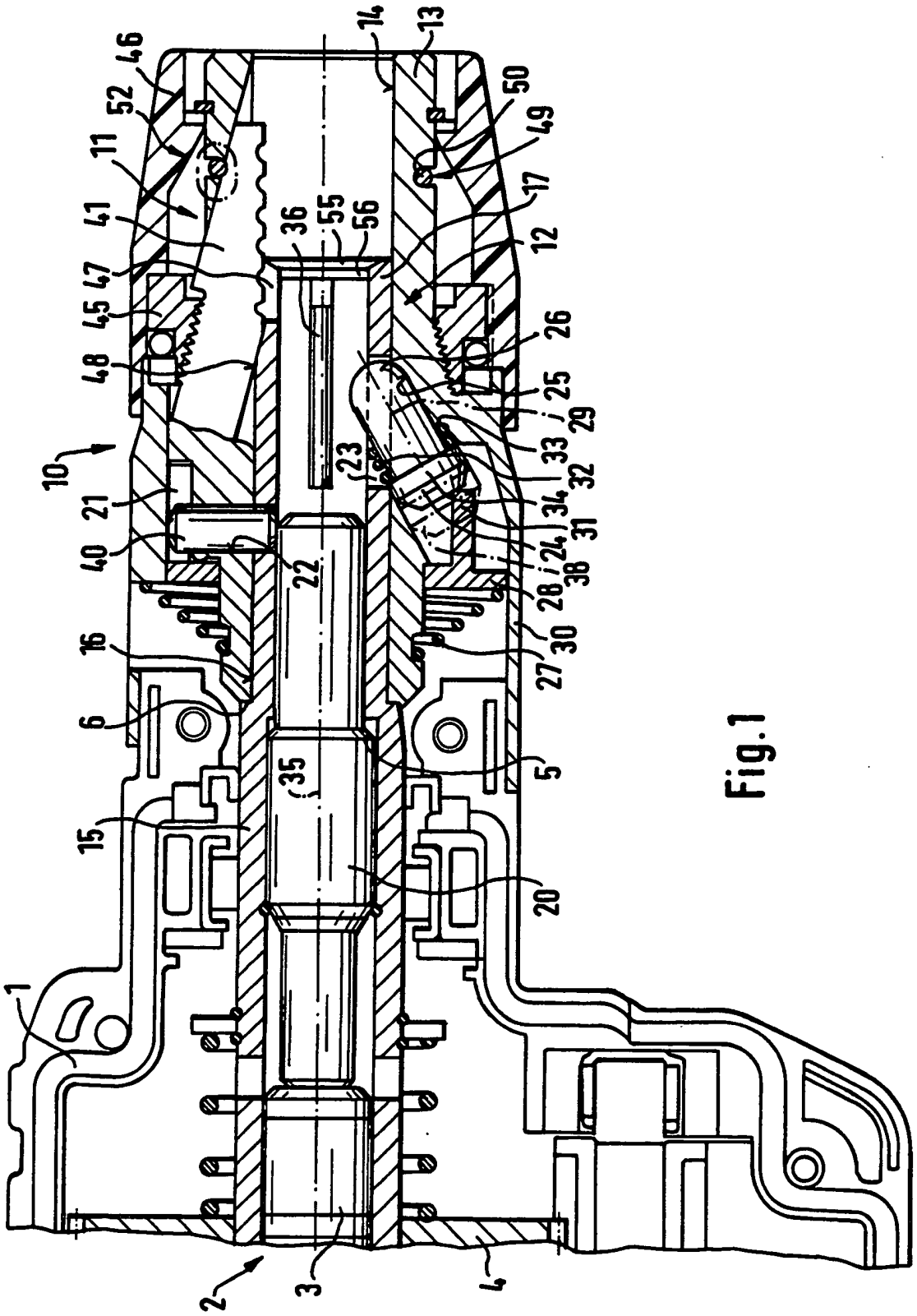
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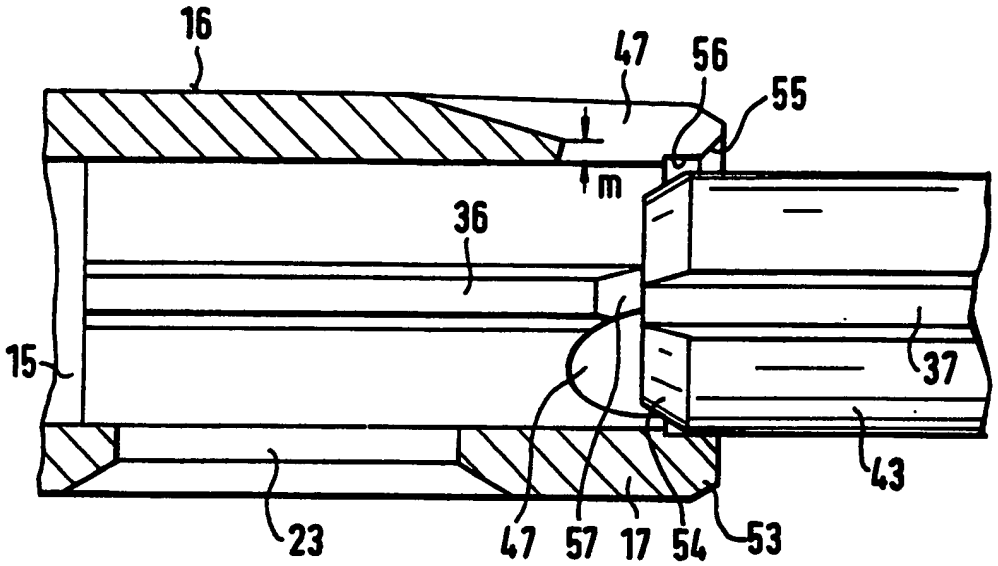
Fig.1

Fig. 2



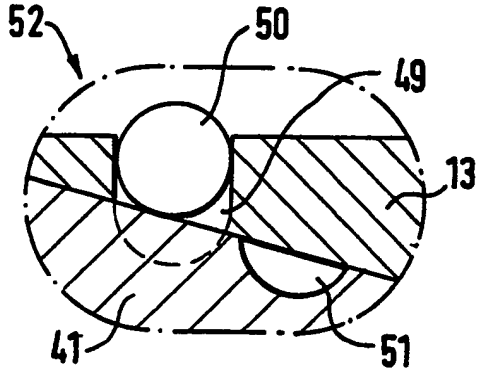


Fig. 3

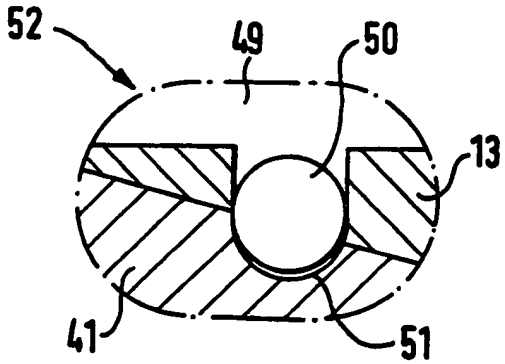


Fig. 4

Fig. 5

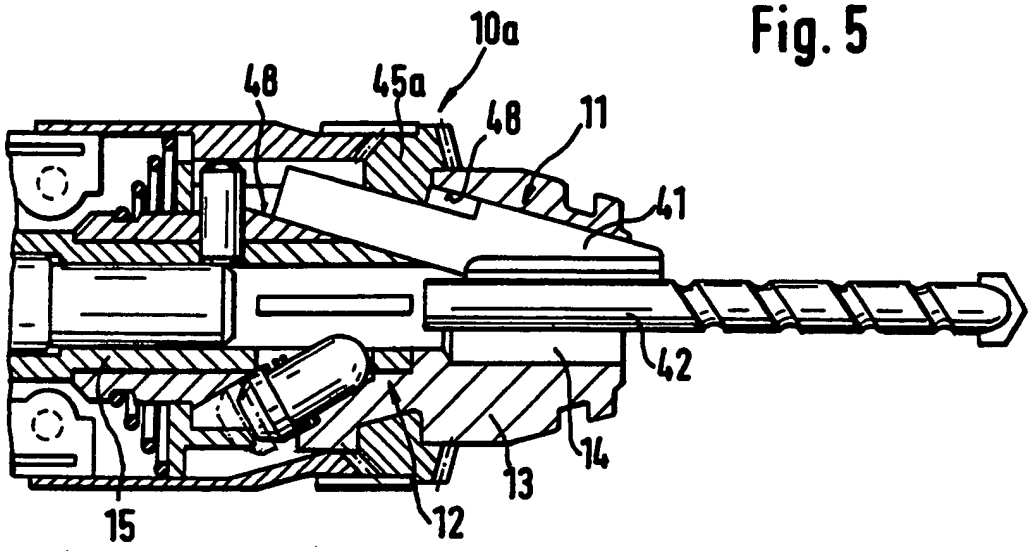

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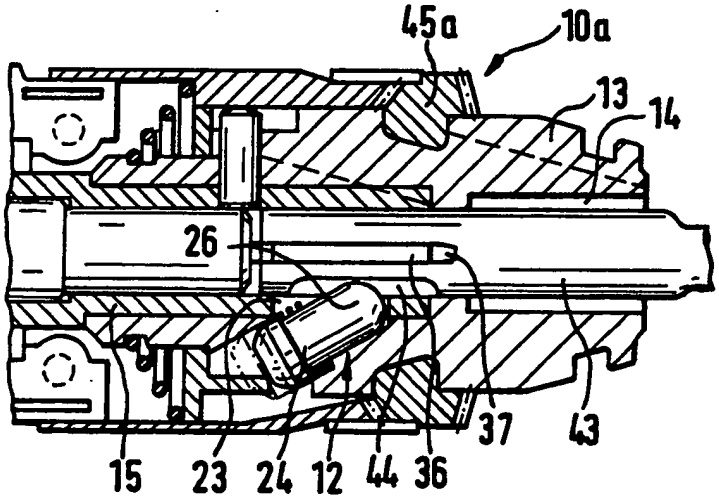
Fig. 6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Hand drill, especially a hammer drill

Prior art

The invention takes as its basis a hand drill of the type according to the main claim. Already known in the art (DE 41 04 131 A1) is a hand drill which has a combination tool-holding system with two functionally separate tool-holding fixtures for tools with a round shank and tools with a grooved shank. By the application of an elaborate production process, these two tool-holding fixtures are combined within one tool holder which has driving mechanisms for rotating inserted round shank and grooved shank tools. Due to the high mechanical load on the rotating drive mechanism when the hand drill is used for impact drilling, the tool holder must be of a hardened construction. Due to the wall geometry of the tool holder, this results in material deformation and adversely affects the concentricity characteristics of the hand drill, especially in rotary drilling with round shank drill bits. In order to avoid the hardening distortion, it has already been proposed to provide the tool holder with hardened inserts. This, however, necessitates an elaborate production process.

Advantages of the invention

The hand drill according to the invention having the characterizing features of the main claim has the advantage, compared with the above-mentioned hand drill, that it possesses a combination tool-holding system which has extremely good concentricity characteristics and also offers

improvements with respect to production capability. The tool holder of the hand drill does not require hardening, thereby avoiding material distortion, and it is not necessary to fit the hand drill with hardened inserts.

Advantageous further developments and improvements of the hand drill specified in the main claim are possible through the measures stated in the sub-claims. It is particularly advantageous to apply a load to the latch pin in the release direction by means of a pressure spring, thereby rendering possible the reliable release of an inserted grooved shank tool. A long overlap with a small amount of play between the hollow spindle and the tool holder provides for a highly precise fit of the tool holder on the hollow spindle, this further improving the concentricity characteristics of the hand drill when tools are clamped between the clamping jaws. The effective overlap between the hollow spindle and the tool holder is further extended by the formation of recesses for the clamping jaws at the end of the hollow spindle. The hollow spindle is reduced to a minimum thickness [m], thereby preventing hardening cracks and distortion in the process of hardening the hollow spindle. The facility to lock the clamping jaws when the hand drill is used in percussive applications prevents self-closing or jamming of the clamping jaws.

Drawing

Embodiments of the invention are represented in the drawing and described in detail in the following description. Figure 1 shows, as a first embodiment, a partial section through a hammer drill constructed with a hand-clamped combination tool-holding system. Figure 2 shows a section through a hollow spindle of a hammer drill at the tool end. Figures 3 and 4 each show a section through a clamping jaw locking device. Figure 5 shows, as a second embodiment, a hammer drill with a key-clamped tool-holding system, with a

round shank tool clamped in place and Figure 6 shows this hammer drill with an inserted grooved shaft tool.

Description of the embodiments of the invention

A hammer drill, represented in Figure 1, has a casing 1, within which there are accommodated a drive motor, not illustrated, and a percussion mechanism 2. Of this percussion mechanism 2, the drawing shows a percussion element 20 to which a load is applied, in an axial direction, by a percussion ram 3. The percussion ram 3 can be driven axially forwards and backwards by any means, for example, by means of a pneumatic cushion or spring percussion mechanism. The percussion ram 3 and the percussion element 20 are located within a hollow spindle 15, which is mounted on bearings so that it is able to rotate relative to the casing 1. The hollow spindle 15, which is composed of hardened steel because of the high stresses to which it is subjected, is rotated by a driving toothed wheel 4.

The inside of the hollow spindle 15 has a reduced cross section at the end 17 which is located away from the percussion mechanism 2. This serves as a stop 5 for the percussion element 20 and prevents it from falling out of the hollow spindle 15. The end 17 of the hollow spindle 15 projects out of the casing 1, a tool holder 13 being located on the outer casing 16 of the hollow spindle 15. The tool holder 13 possesses a first tool-holding fixture 11 for holding round shank tools 42 (Figure 5). A second tool-holding fixture 12, which is functionally separate from the first, for holding tools with a grooved shank 43 (Figure 6) is formed partly within the hollow spindle 15 and partly on the tool holder 13. Inserted grooved shank tools 43 are guided and rotationally driven within the hollow spindle 15, being secured in a forward axial direction by a locking mechanism formed on the tool holder 13. The first tool-holding fixture

11 and the second tool-holding fixture 12 together form a combination tool-holding system 10 in the hand drill.

The first tool-holding fixture 11 is constructed, in the known manner, as a hand-clamped jaw chuck, for which there are formed within the tool holder 13 of the combination tool-holding system 10 three guideways 48, slanting inwards in a forward direction, for three moving clamping jaws 41. The backs of the clamping jaws 41 are toothed in the usual manner and can be adjusted within the guideways 48 by means of a threaded ring 45. The threaded ring 45 is coupled with a clamping sleeve 46 so that it rotates together with the clamping sleeve 46 and is manually operated by turning the latter.

By contrast, the combination tool-holding system 10a represented in Figures 5 and 6 has a toothed gear rim 45a which is adjusted, in the known manner, by means of a drill chuck key. The same reference numbers are used in the drawing to indicate other parts which are the same as each other and which perform the same functions.

The tool holder 13 is located on the end 17 of the hollow spindle 15. For this purpose, a through-opening 14 passing through the centre of the tool holder 13 has an internal diameter of sufficient magnitude such that the tool holder 13 is disposed concentrically relative to the hollow spindle 15 with a minimum radial play and such that there is a maximum length of overlap with the outer casing 16 of the hollow spindle 15. One or more pins 40 disposed within a radial bore 22 hold the tool holder 13 and the hollow spindle 15 interlocked relative to each other in a circumferential direction and in a forward axial direction. The rear end of the tool holder 13 facing the hollow spindle 15 bears axially on an external collar 6 of the hollow spindle 15. The pin 40 is prevented, in an inward direction, from falling out of the radial bore 22 by the percussion element 20 and, in a forward

direction, by an axially displaceable control sleeve 30. The pin 40 engages in a groove 21 disposed axially in the control sleeve 30, thereby preventing the control sleeve 30 from being rotated in the circumferential direction.

Grooved shank tools 43 (Figure 6) are fixed in place by means of a second tool-holding fixture 12, the grooved shank tool 43 being held within the hollow spindle 15 with a minimum radial play. On the inner wall of the hollow spindle 15, in the area of the end 17, there are disposed one or more gib-type rotational drivers 36 which serve as mechanisms to provide rotational drive, the rotational driver 36 engaging in a rotational drive groove 37 in the grooved shank tool 43 for the purpose of transmitting the rotational movement to the grooved shank tool 43 inserted in the second tool hold-holding fixture 12.

The grooved shank tool 43 inserted in the hollow spindle 15 is fixed in a forward axial direction, while being capable of axial displacement, by means of locking mechanisms, formed on the tool holder 13, which have a latch pin 24 (Figure 1), capable of displacement in a radial direction, disposed within a locating bore 25 which slants inwards in a forward direction within the tool holder 13. The locating bore 25 has a radial axis 29 which is inclined towards the rear part of the hammer drill and intersects a longitudinal axis 35 of the hammer drill at an acute angle. The front part 26 of the latch pin 24 is rounded in a hemispherical form. When the latch pin 24 is in the locking position shown in Figure 6, the front part 26 engages in the interior of the hollow spindle 15, through a hole 23 in the hollow spindle 15 (see also Figure 2). When a grooved shank tool 43 is inserted, the latch pin 24 engages in a locking groove 44 in the grooved shank tool 43, locking the latter in a forward direction while permitting a limited axial displacement. The axial displacement of the inserted grooved shank tool 43 is limited in a backward direction by the percussion element 20.

The latch pin 24 is held in this position by a stop element 28 (Figure 1) which is loaded in the locking direction by a return spring 27. The stop element 28 is annular in form, with a projection 31 which overlaps the latch pin 24. The stop element 28 can be moved by means of the control sleeve 30 against the force of the return spring 27, so that the latch pin 24 can be released from its locking position. To facilitate release of the latch pin 24, force is applied to it by means of a pressure spring 32 which bears on both a shoulder 33 within the locating bore 25 in the tool holder 13 and an annular collar 34 located on the latch pin 24. The spring force of the pressure spring 32 is less than that of the return spring 27, so that the pressure spring 32 is tensible by the return spring 27 when the latch pin 24 is in the locking position. When the latch pin 24 is released by the stop element 28, the pressure spring 32 automatically moves the latch pin 24 into the release position 38 indicated by the broken line in Figure 1, enabling an inserted grooved shank tool 43 to be removed from the second tool-holding fixture 12.

In percussive applications, a load is applied directly to the grooved shaft tool 43 by the percussion element 20, the clamping jaws 41 of the first tool-holding fixture 11 being in an open position and the grooved shank tool 43 being able to move freely towards the clamping jaws 41. The combination tool-holding system 10 represented in Figure 1 is equipped with a clamping jaw locking device 52, shown in greater detail in Figures 3 and 4. The clamping jaw locking device 52 has a slotted annular element 50 located in an annular groove 49 formed in the tool holder 13. The slot in the annular element 50 renders it capable of expansion followed by inward tensioning. The annular groove 49 is located at a depth within the tool holder 13 such that it passes completely through the wall of the tool holder 13 in the area of the guideways 48 of the clamping jaws 41, so that the annular element 50 bears on the clamping jaws 41 at that point. The

annular element 50 engages in one or more latch grooves 51 provided in the front part of each of the clamping jaws 41.

Fig. 3 shows the clamping jaw locking device 52 in the unlocked position, in which the clamping jaws 41 are pushed inwards towards a tool which is to be clamped in position. The annular element 50 bears on the outer surface of the clamping jaws, being thereby tensioned inwards. If the clamping jaws 41 are moved backwards out of the position shown in Figure 3 towards the open position of the jaw chuck, the pretensioning of the annular element 50 in the open position of the clamping jaws 41 causes it to engage in the latch grooves 51, thereby securing the clamping jaws 41 against self-closing or further opening (Figure 4). As shown in the drawing, the annular groove 49 can taper radially inwards.

The function of the clamping jaw locking device 52 is to prevent the clamping jaws 41 becoming displaced in a hand drill fitted with a hand-clamped drill chuck and in percussive applications, when the clamping jaws 41 move freely. Closing of the clamping jaws 41 could limit the axial displacement capability of the grooved shank tool 43 inserted in the second tool-holding fixture 12, thereby reducing the percussive effect. On the other hand, the clamping jaws 41 could be opened so widely that they become jammed with the threaded ring 45 in their maximum opening position, so that they can no longer be closed by hand.

Figure 2 is a detailed representation of the front part of the hollow spindle 15. The reduced outer casing 16 of the hollow spindle 15 is of maximum length in order to achieve a maximum overlap, expressed by the ratio of the length [l] of the part of the hollow spindle 15 which engages in the tool holder 13 to the internal diameter [d] of the through-opening 14 (overlap l/d). The greater the overlap, with a minimum of play, the greater is the precision of the fit of the tool holder 13 on the hollow spindle 15 and, consequently, the

trueness of the concentricity of the hammer drill. Advantageous concentricity characteristics are attainable from an overlap ratio of about 2/1, the ratio in the embodiment illustrated being about 2.5/1. The effective part of the overlap is further increased through the formation of recesses 47 in the area of the end 17 of the hollow spindle 15. The clamping jaws 41 project into the recesses, which extend as an elongation of the guideways 48 for this purpose. The rest of the cross section of the hollow spindle 15 which forms tongue-shaped projections 53 between the recesses 47 also serves as a bearing surface for the tool holder 13. The rotational driver 36 is also located in the area of the projections 53 so that the axial distance between the first tool-holding fixture 11 and the second tool-holding fixture 12 is small with, at the same time, the rotational driver 36 being of maximum length.

Insertion of a tool into the second tool-holding fixture 12 is facilitated by insertion bevels 55 located on the front end of the hollow spindle 15 in the area of the projections 53 and a mating bevel 54 on the grooved shank tool 43. The internal diameter of the hollow spindle 15 has an enlargement 56 immediately adjacent to the insertion bevels 55, facilitating pre-centring of the grooved shank tool 43 which is to be inserted, this being extremely advantageous due to the relatively long insertion path through the opening 14 in the tool holder 13 to the hollow spindle 15. Figure 2 shows the pre-centred grooved shaft 43 in the hollow spindle 15 and the insertion bevels 55 at the tool end of the hollow spindle 15, the bevels opening into the enlargement 56 of the internal diameter. The tool is twisted so that the rotational drivers 36 and the rotational drive grooves 37 coincide, enabling the tool to be inserted further. A bevel 57 at the tool end of the rotational driver 36 is advantageous.

The tool shank is then inserted further into the second tool-holding fixture 12 until it comes to bear on the latch pin 24. This pin is then pushed backwards, together with the stop

element 28, against the force of the return spring 27, displacing the latch pin 24 radially outwards within the locating bore 25 and releasing the inside of the hollow spindle 15. The tool can then be inserted deeper into the hollow spindle 15, the latch pin 24 finally snapping into the locking groove 44. The grooved shank tool 43 is then prevented from falling forwards out of the tool-holding fixture 12.

The combination tool-holding system 10 according to the invention is suitable for holding rotary drilling tools, impact drilling tools, impact tools and screwdriving tools. The concentricity characteristics of the combination tool-holding system 10 with inserted grooved shank tools 43 are improved by the fact that the tools are guided and rotated directly within the hollow spindle 15, while good concentricity characteristics are attainable with round shank tools 42 due to non-hardened tool holder 13. Hardening cracks and hardening deformation on the hollow spindle 15 are prevented through the avoidance of thin walls between the projections 53 of the hollow spindle 15. The tapered cross section of the wall of the hollow spindle 15 in the area of the radially oblique recesses 47 is therefore reduced to a minimum dimension [m]. In the hammer drill illustrated in Figures 5 and 6, the through-opening 14 has differing internal diameters, while the through-opening 14 in the embodiment according to Figure 1 has a constant, non-reduced, internal diameter, thereby reducing the time requirement for machining the tool holder 13. The formation of the enlargement 56 in addition to the insertion bevel 55 on the hollow spindle 15 can also be advantageous in a hand drill equipped only with a tool-holding fixture for grooved shank tools 43.

Claims

1. Hand drill, especially a hammer drill, with a combination tool-holding system (10) for rotary drilling tools, impact drilling tools, impact tools and screwdriving tools, the combination tool-holding system (10) having a tool-holding fixture (11), in the form of a jaw chuck with adjustable clamping jaws (41), for round shank tools (42) and a functionally separate second tool-holding fixture (12), possessing rotational driving and/or locking mechanisms, for grooved shank tools (43), and having a tool holder (13), with a central through-opening (14), which is coupled with a driven rotating hollow spindle (15) so that it rotates together with the latter, within which there is disposed a percussion element (20) which moves axially forwards and backwards and acts directly on a tool held in the second tool-holding fixture (12) in percussive operation, characterized in that the tool holder (13) is located on the outer casing (16) of the hollow spindle (15), one end (17) of the hollow spindle (15), facing the tool holder (13), engaging in the through-opening (14) and possessing means for rotational driving for the grooved shank (43) of a grooved shank tool (43) capable of being inserted into the second tool-holding fixture (12).

2. Hand drill according to Claim 1, characterized in that the means for locking the grooved shank tools (43) have a predominantly cylindrical latch pin (24) with a front part (26), rounded in the form of a hemisphere, which moves within a locating bore (25) in the wall of the tool holder (13) and engages, through a hole (23) in the wall of the hollow spindle

(15), in a locking groove (44) formed in the grooved shank tool (43), the latch pin (24) being moved into its locking position by means of an axially mobile stop element (28) under the applied force of a return spring (27), the latch pin (24) being released only when the stop element (28) has been displaced against the action of the return spring (27).

3. Hand drill according to Claim 2, characterized in that a load is applied to the latch pin (24) by a pressure spring (32) which is tensioned when the latch pin (24) is in the locking position and, following release by the stop element (28), serves to disengage the latch pin (28) from the locking groove (44).

4. Hand drill according to Claim 3, characterized in that the pressure spring (32) bears on both a shoulder (33) in the locating bore (25) and a collar (34) formed on the latch pin (24).

5. Hand drill according to any one of Claims 2, 3 or 4, characterized in that the locating bore (25) has a radial axis (29) which is inclined towards the rear part of the hand drill so that it intersects a longitudinal axis (35) of the combination tool-holding system (10) at an acute angle.

6. Hand drill according to Claim 1, characterized in that the means for rotational driving have the form of gib-type rotational drivers (36), disposed on the inside wall of the end (17) of the hollow spindle (15) engaging in the through-opening (14), which serve to engage in corresponding rotational drive grooves (37) in a grooved shank tool (43).

7. Hand drill according to Claim 1, characterized in that the central through-opening (14) has a constant, non-reduced, internal diameter over the full axial length of the tool holder (13).

8. Hand drill according to Claim 1, characterized in that the tool holder (13) is mounted on the end (17) of the hollow spindle (15), where its circumferential and axial fit are delimited by one or more pins (40).

9. Hand drill according to Claim 8, characterized in that the ratio of the length [l] of the part of the hollow spindle (15) engaging in the tool holder (13) to the internal diameter [d] of the through-opening (14) [overlap l/d] is greater than 2.

10. Hand drill according to Claim 1, characterized in that the clamping jaws (41) are disposed within guideways (48) formed in the tool holder (13) and that the end (17) of the hollow spindle (15) has radially oblique recesses (47) which extend the guideways (48), matching the form of the clamping jaws (41) which project into the recesses.

11. Hand drill according to Claim 10, characterized in that the recesses (47) are reduced in the direction of the end (17) to a minimum wall thickness [m] of the hollow spindle (15).

12. Hand drill according to Claim 1, characterized in that the clamping jaws (41) are disposed within guideways (48) formed in the tool holder (13) and can be locked in one or more opening positions of the first tool-holding fixture (11).

13. Hand drill according to Claim 12, characterized in that the outside of the tool holder (13) has an annular groove (49) which passes through the wall of the tool holder (13), in the form of a slot, in the area of the guideways (48) and within which there is disposed an annular element (50) which engages in corresponding latch grooves (51) in the clamping jaws (41) under tension applied radially inwards in one or more open positions.

14. Hand drill according to Claim 13, characterized in that the annular grove (49) tapers towards the clamping jaws (41).

15. Hand drill according to Claim 1, characterized in that at the tool end of the hollow spindle (15) there is an insertion bevel (55) which opens into an enlargement (56) of the internal diameter of the hollow spindle (15).

16. Tool holder for a hand drill, especially for a hammer drill, the tool holder (13) being coupled with a driven rotating hollow spindle (15) of the hand drill so that it rotates together with it and possessing a tool-holding fixture (11), in the form of a jaw chuck, for round shank tools (42) and means, functionally separate from the jaw chuck, for axial locking of a grooved shank tool (43), the tool holder (13) having a central through-opening (14), characterized in that the tool holder (13) is located concentrically on the outer casing (16) of the hollow spindle (15) so that it rotates together with the latter and that the through-opening (14) has an internal diameter of sufficient magnitude such that when the tool holder (13) is located on the hollow spindle (15) a grooved shank tool (43) can be inserted with radial play, passing through the through-opening (14) into one end (17) of the hollow spindle (15) and locked within the latter, allowing a limited amount of axial movement.

17. A hand drill substantially as herein described with reference to the accompanying drawings.

18. A tool holder for a hand drill, substantially as herein described with reference to the accompanying drawings.

Examiner's report to the Comptroller under Section 17 (The Search report) — 14 —	GB 9416933.1
Relevant Technical Fields (i) UK Cl (Ed.M) B4C; B3B (ii) Int Cl (Ed.5) B23B (31/00, 02, 12, 171, 20); B25D (17/08)	Search Examiner H F YOUNG Date of completion of Search 29 SEPTEMBER 1994
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Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2030485 A	(BOSCH) see Figure 1 and lines 49-101 on page 1	1
A	EP 0456003 A1	(BOSCH) see figures	1

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